



Alcohol and marijuana use among college students: economic complements or substitutes?

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Summary

Previous research has shown that the recent tightening of college alcohol policies has been effective at reducing college students' drinking. Over the period in which these stricter alcohol policies have been put in place, marijuana use among college students has increased. This raises the question of whether current policies aimed at reducing alcohol consumption are inadvertently encouraging marijuana use. This paper begins to address this question by investigating the relationship between the demands for alcohol and marijuana for college students using data from the 1993, 1997 and 1999 waves of the Harvard School of Public Health's College Alcohol Study (CAS). We find that alcohol and marijuana are economic complements and that policies that increase the full price of alcohol decrease participation in marijuana use. Copyright © 2004 John Wiley & Sons, Ltd.

Keywords demand; marijuana; alcohol; economic complements

Introduction

Prevalence statistics from population surveys consistently show that substance use and abuse among college students is higher than estimates from the general population. For example, the 1999 Monitoring the Future Survey (MTF) reports annual prevalence rates for alcohol, marijuana and any illicit drug use among college students to be 83.6, 35.2 and 36.9%, respectively [1]. By comparison, the 1999 National Household Survey on Drug Abuse (NHSDA) reports prevalence rates for young adults aged 19–28 of 84.1% for alcohol use, and 27.6, and 30.3%, respectively for marijuana and any illicit drug use [2]. The higher use rates among college samples are particularly

disturbing because they are frequently accompanied by serious health consequences, acts of violence and/or crime, poor performance in school, and other negative outcomes [3,4].

In an effort to reduce substance use and abuse among college students, Congress passed the Drug-Free Schools and Communities Act of 1986, which set aside funds for substance abuse prevention programs in higher education. Nonetheless, the first survey on drinking and illicit drug use on college campuses, the 1993 College Alcohol Study (CAS), found that 84% of college students had used alcohol in the past year [4] and that one in four (24.8%) students had used marijuana in the past year [5]. As media attention on alcohol-related tragedies occurring on college campuses

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heightened, a new wave of private and public initiatives aimed at curbing underage and youthful drinking began. These initiatives included the campaigns of the National Association of State Universities and Land Grant Colleges, the Robert Wood Johnson Foundation's Matter of Degree program, and the US Department of Education Fund for Improvement of Secondary Education Programs [6]. In addition, numerous states and localities began passing tighter alcohol control policies specifically targeting alcohol use and abuse among minors.

Recent research shows that some of these state and local policies have been effective at reducing alcohol use and abuse among college students. In particular, higher beer taxes, tougher drunk driving laws, state restrictions on happy hour pricing and restrictions on social access have all been associated with reduced drinking and/or binge drinking among college students [7,8]. In addition, some campus policies, such as total bans on drinking on campus, have been associated with an increased level of abstinence from alcohol use and lower levels of heavy episodic drinking among college students [9]. At the same time, however, marijuana use among college students has been on the rise. Trend data from the 1993 and 1999 CAS show an increase in 30-day prevalence rates of marijuana use of 21.7% (a 2.8 percentage point increase) from 1993 to 1999 [10]. Data from the Monitoring the Future Survey (MTF) show a rise in 30-day prevalence rates of marijuana use among college students one to four years beyond high school of 46.0% (a 6.5 percentage point increase) from 1993 to 1999.

The rise in marijuana use during a period in which tougher alcohol policies have been enacted raises the question as to whether these alcohol policies have had the unintended consequence of raising illicit drug use among the college population. If alcohol and marijuana are economic substitutes for college students then these policies may not have the overall effect desired. However, it may be the case that the recent rise in college students' marijuana use merely reflects a broader societal trend that is independent of the policies being enacted. Evidence supporting this alternative hypothesis comes from data showing that prevalence rates for other illicit drugs (excluding marijuana) also rose during the same time period [10].

This paper begins to explore whether recent alcohol restrictions have increased the use of marijuana by examining the economic relationship

between the demands for alcohol and marijuana among college students. Previous studies examining the issue of complementarity and substitutability between alcohol and marijuana are inconclusive and do not explicitly address the relationship between these two substances in this key population. We begin by examining own- and cross-price effects in annual and 30-day prevalence equations for alcohol and marijuana for all students. Additional policy variables capturing the non-monetary components of price, such as accessibility and the legal environment for using each substance, are also examined. We find evidence that alcohol and marijuana are economic complements. Specifically, we find that increasing the monetary costs of marijuana use decreases participation in both marijuana and alcohol use. Also, policies that reduce access to alcohol, such as banning alcohol consumption on campus or state laws restricting happy hours, reduce both alcohol and marijuana use.

We then examine whether differences exist in the relationship between these two substances by gender and age. Although we find that alcohol use by males and females respond differently to campus alcohol bans, both males and females are less likely to use marijuana on campuses where alcohol consumption has been banned. We find no difference in the impact of policy variables on marijuana or alcohol use across individuals less than 21 compared to those of legal drinking age.

The rest of this paper is organized as follows. In the following section we review the literature on the relationship between alcohol and marijuana use. Then we present the statistical model on which our empirical work is based. Next, the data used in this study, and the results are described. Finally we conclude with a discussion of our findings.

Literature review

During the past decade a growing economic literature has emerged investigating the contemporaneous relationship between the demands for alcohol and marijuana in the general and youth populations. Initial studies evaluating the relationship between demands in youth and young adult populations concluded that alcohol and marijuana were economic substitutes [11,12]. Subsequent articles that have attempted to include additional proxies for the price of marijuana or that have

weak evidence that males' and females' participation in marijuana use have a differential response to fines for the possession of marijuana and attending a campus with one bar within a mile of the campus, although the effect of these variables is imprecisely estimated for both males and females.

The results from this analysis find no evidence of a significant difference in the effect of the price of marijuana on either alcohol or marijuana use across gender. The findings with respect to the monetary price of marijuana suggest that alcohol and marijuana are economic complements for both males and females. The conclusion of complementary is further supported by the negative and statistically significant affect of bans on both alcohol and marijuana consumption for females, and by the negative and statistically significant affect of bans on marijuana consumption for males.

We follow the same strategy to determine whether there are age differences between college students in terms of their response to policy variables. The p -value for testing the null hypothesis that the interaction terms on the policy variables are jointly insignificant in the bivariate probit model for alcohol and marijuana use is 0.35. We therefore conclude that there is insufficient evidence to indicate a difference in the response to any of the policy variables on alcohol and marijuana use across these two age groups. Demographic and background variables, such as gender and parental drinking, appear to be driving the differences in demand of students who are minors compared to those of legal drinking age.

Discussion

It is extremely difficult to draw a clear conclusion of the relationship between the demands for alcohol and marijuana from the existing literature for several reasons. First, many of the early studies suffer from a clear omitted variable bias due to the exclusion of a measure for the price of marijuana. Second, studies have been conducted on cohorts drawn from different time periods (1980s versus 1990s) and at different points in the life-cycle (high school seniors, young adults, all adults). It is entirely possible that the relationship between the demands for these two substances varies by age and is influenced by larger social trends that are unique to specific cohorts. Finally, current mea-

asures of alcohol use employed by social scientists (e.g. use in the past year or use in the past month) represent very different drinking behaviors and drinking populations, and thus findings with respect to a particular measure of drinking behavior may not be generalizable to other drinking behaviors.

In this study we attempt to overcome many of these limitations by focusing on a single population, college students, from a single period (the 1990s). We further attempt to address the problem of aggregation and/or sampling bias by doing additional analyses by gender and age (minor vs adult). We include the best measure of marijuana prices available to us so as to reduce the influence of omitted variable bias. We recognize, however, that our price variable is imperfectly measured and hence try to reduce the effect of measurement error by including measures of the 'quality' of our price data in all our analyses. Finally, we examine the relationship between marijuana use and two specific drinking behaviors that are more easily compared to other populations: use of alcohol in the past year and use of alcohol in the past month.

Given these parameters, the evidence from this study, generated from examination of own- and cross-price effects, suggests that alcohol and marijuana are economic complements for college students. The strongest and most consistent evidence comes from findings with respect to the price of marijuana, which is shown to be negatively related to both alcohol and marijuana participation. This negative relationship between price and participation does not appear to be driven by any one particular demographic group dominating the sample, although insufficient sample size precludes us from doing a careful analysis by race/ethnicity.

In addition to finding a negative relationship between the monetary price of marijuana and the probability of using both marijuana and alcohol, results with respect to college level measures of social access to alcohol also support a complementary relationship. In particular, campus bans on alcohol use are associated with a lower probability of using alcohol and marijuana in the general model, for females, and across different age groups. The statistical significance of this relationship remains for males' marijuana use, although it appears that males' alcohol use is not responsive to college level bans. It may be the case that men are less sensitive to college drinking bans because of self-selection, i.e. men who think it is important to

drink on campus go to schools that allow drinking on campus. A more careful analysis that enables researchers to account for self-selection into colleges may provide additional insight regarding the significance of this differential finding. Evidence from models including the beer tax and state level policies governing access to alcohol provide further support for a complementary relationship between alcohol and marijuana use for the full sample and all sub-samples evaluated.

The evidence from this study suggests that recent efforts to reduce college students' social access to alcohol has not contributed to the rise in marijuana use among this group. In particular, we find that campus bans on alcohol use are associated with a lower prevalence of marijuana use. In addition, state-level efforts to reduce college drinking, such as prohibiting happy hours, also appear to reduce the prevalence of both alcohol and marijuana use during this time period. Our results suggest that the more likely explanation for the rise in marijuana use among college students is the fact that college students' use of marijuana is price responsive. Given that the price of marijuana has dropped significantly during the past decade, it is not surprising that the prevalence of use in this price responsive group has risen [24].

If alcohol and marijuana are truly economic complements for college students, as our study suggests, then several important policy implications can be drawn. First, it implies that the high marijuana prices associated with its prohibition have the added benefit of diminishing alcohol use in this high-risk population. A second policy implication of this study is that policies that are effective at reducing drinking among college students, such as banning the consumption of alcohol on campus and prohibiting happy hours, appears to have the additional benefit of reducing marijuana use as well.

One final observation warrants mentioning. In all of the models evaluated, we included a measure of the price of cigarettes to help control for interdependencies in the demands for alcohol, marijuana and cigarettes. However, in our sample the price of cigarettes has an insignificant effect on both alcohol and marijuana use in all specifications. This suggests that for college students there is no significant relationship between cigarettes and alcohol use and/or cigarettes and marijuana use, but further investigation may be warranted given that we do not control for other aspects of tobacco control policy.

Acknowledgements

We gratefully acknowledge research support for this paper from the Robert Wood Johnson Foundation through ImpacTeen and Substance Abuse Policy Research Program (SAPRP) and to Wechsler through the College Alcohol Study. Dr Pacula's work was also partially supported by a grant from the National Institute on Drug Abuse (Grant number R01DA12724-0).

Appendix A

The price of an ounce of marijuana by year and site are given in Table A1 and Table A2. The full set of bivariate probit results for 30-day prevalence of alcohol and marijuana use are given in Tables A3 and A4 respectively.

Table A1. The DEA 19 cities price of an ounce of commercial quality marijuana: by year

Year	<i>N</i>	Mean	Standard deviation
1993	55	74.62	37.58
1994	54	67.86	34.35
1995	53	74.29	47.56
1996	56	67.14	35.98
1997	37	50.82	23.26
1998	41	55.24	30.64
1999	29	53.1	29.1

Table A2. The DEA 19 cities price of an ounce of commercial quality marijuana: by site

Site	<i>N</i>	Mean	Standard deviation
1	21	81.96	31.59
2	25	63.11	42.42
3	18	96.98	25.51
4	18	49.01	19.02
5	7	130.34	62.33
6	22	66.76	25.92
7	18	34.79	10.85
8	10	134.16	61.67
9	19	50.37	12.49
10	12	67.79	3.08
11	14	79.26	49.13
12	23	60.40	18.39
13	25	71.30	18.91
14	15	40.26	9.68
15	4	46.61	17.02
16	14	50.18	43.75
17	7	108.55	25.48
18	9	75.72	18.00
19	21	59.00	13.10